

Engine and Auxiliary Systems

Edited by
Prof. Dr. A.K.M. Mohiuddin



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

Engine and Auxiliary Systems

Edited by Prof. Dr. A.K.M. Mohiuddin



IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

A.K.M. Mohiuddin
Engine and Auxiliary Systems
A.K.M. Mohiuddin

ISBN: 978-967-418-216-8

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN. BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan

Table of Contents

Preface	iv
Table of Contents	v
Chapter 1	
<i>Experimental analysis and comparison of performance characteristics of catalytic converters</i> A.K.M. Mohiuddin	1
Chapter 2	
<i>Experimental analysis and simulation of catalytic converters</i> A.K.M. Mohiuddin	8
Chapter 3	
<i>Thermal design of mechanical devices using expert system</i> A.K.M. Mohiuddin	14
Chapter 4	
<i>Exhaust system optimization using GT- Power</i> A.K.M. Mohiuddin	21
Chapter 5	
<i>Experimental analysis to determine the relationship between noise and back pressure for muffler design – Part I: Muffler design requirements</i> A.K.M. Mohiuddin	29
Chapter 6	
<i>Experimental analysis to determine the relationship between noise and back pressure for muffler design – Part II: Experimental results</i> A.K.M. Mohiuddin	36
Chapter 7	
<i>2nd Generation IIUM Buggy Car – Part I: Design</i> A.K.M. Mohiuddin	42
Chapter 8	
<i>2nd Generation IIUM Buggy Car – Part II: Fabrication</i> A.K.M. Mohiuddin	48
Chapter 9	
<i>Robust design optimization of valve timing using multi-objective genetic algorithm (MOGA)</i> A.K.M. Mohiuddin and Yap Haw Shin	53
Chapter 10	
<i>A study of an aftermarket voltage stabilizer for its performance and emission on passengers vehicle</i> A.K.M. Mohiuddin, Sany Izan Ihsan and Noor Azammi Abd Murat	60

Chapter 11	
<i>Investigation of engine performance using designed swirl adapter</i>	67
A.K.M. Mohiuddin	
Chapter 12	
<i>Comparison of various types of powertrain used in automotive vehicles in terms of performance and emission</i>	74
A.K.M. Mohiuddin and Ali Faiz	
Chapter 13	
<i>Automotive catalytic converters: Current status and some future perspectives</i>	80
A.K.M. Mohiuddin and Jalal Mohammed Zayan	
Chapter 14	
<i>3-Cylinder gasoline direct injection as opposed to 4-cylinder multi-port fuel injection for lower fuel consumption and NO_x emission</i>	86
A.K.M. Mohiuddin and Anwar bin Mohd Sood	
Chapter 15	
<i>Investigation of Spark Ignition Multipoint Engine Using Water Addition - Part I: Simulation</i>	92
A.K.M. Mohiuddin and Mohammad Edilan Bin Mustaffa	
Chapter 16	
<i>Investigation of Spark Ignition Multipoint Engine Using Water Addition - Part II: Performance and Emission</i>	101
A.K.M. Mohiuddin and Mohammad Edilan Bin Mustaffa	
Chapter 17	
<i>Thermodynamic Analysis of Combustion of CAMPRO CFE Engine – Part I: Simulation</i>	109
A.K.M. Mohiuddin, Izzarief Bin Zahari and Abdullah Aiman	
Chapter 18	
<i>Thermodynamic Analysis of Combustion of CAMPRO CFE Engine – Part II: Combustion Analysis</i>	116
A.K.M. Mohiuddin, Izzarief Bin Zahari and Abdullah Aiman	
Chapter 19	
<i>Development of Low Cost Catalytic Converter from Non-Precious Metals</i>	123
A.K.M. Mohiuddin	
Chapter 20	
<i>Performance Investigation of Energy Efficient Hybrid Engine towards Green Technology</i>	131
Ataur Rahman	
Chapter 21	
<i>Production of Aluminum-Silicon Carbide Composites Using Powder Metallurgy at Sintering Temperatures above the Aluminum Melting Point Part II</i>	138
Yasin Nimir	
Chapter 22	
<i>Comparison between composites reinforced with natural and synthetic fibers: Part I</i>	143
Yasin Nimir	

Chapter 23	
<i>Comparison between composites reinforced with natural fibres and synthetic fibres Part II</i>	151
Yasin Nimir	
Chapter 24	
<i>Production of Aluminium reinforced with SiC particulates using powder metallurgy</i>	156
Yassin Nimir	
Chapter 25	
<i>Development of automatic magnetic particle system for automotive parts inspection</i>	160
Meftah Hrairi, Mohd Shah Bin Rizal, Salah Echrif	
Chapter 26	
<i>Performance of an Automatic Magnetic Particle Inspection of Automotive Parts</i>	166
Meftah Hrairi, Mohd Shah Bin Rizal, Salah Echrif	
Chapter 27	
<i>Numerical simulation of complex turbulent flows</i>	172
Asif Hoda	
Chapter 28	
<i>Direct numerical simulation (DNS) and large eddy simulation (LES)</i>	177
Asif Hoda	
Chapter 29	
<i>Reynolds averaged navier stokes (RANS) Simulation</i>	182
Asif Hoda	
Chapter 30	
<i>Film Cooling of Turbine Blades</i>	192
Asif Hoda	

Chapter 19

Development of Low Cost Catalytic Converter from Non-Precious Metals

A.K.M. Mohiuddin

Department of Mechanical Engineering, International Islamic University Malaysia

Abstract

The purpose of this chapter is to discuss the uses of non-precious metals for the development catalytic converters. Copper powder and nickel catalyst were chosen as the alternative **catalysts** to reduce the use of precious group metals (PGMs) platinum, palladium, and rhodium. Simulation by COMSOL has shown that Nickel and copper were very effective in reducing NO_x during rich condition of air-fuel mixture while oxidizing CO and HC during lean condition. Simulations using FLUENT and COMSOL have shown the actual characteristics of the catalytic converter performance. The flow throughout catalytic converter and the backpressure have successfully determined. Furthermore, catalyst conversion efficiency also has been shown clearly. On the other hands, the experimental results have excellently validated the simulation results in terms of the nature and trends of the catalytic converter performance as well as its efficiency. Catalyst distribution and application of the non-zoning monolith substrates have further contributes to cut down the production cost.

Keywords: catalytic converter, non-precious metals, simulation, conversion efficiency, performance characteristics.

Introduction

Automotive catalysts work as three-way catalysts converting carbon monoxide (CO), hydrocarbons, and nitric oxide (NO_x), the three major pollutants into CO₂, N₂ and H₂O. The reactions that occur in the catalytic converter are due to a catalyst. The catalyst is in a separate phase to the reactants is said to be heterogeneous, or contact catalyst. Contact catalysts are materials with the capability of adsorbing molecules of gases or liquids onto their **surfaces**. Presently, the most widely used three-way catalysts in gasoline engines are ceramic **honeycomb** supports containing noble metals such as platinum, rhodium, and palladium. These catalysts are often called as the precious metals because they are used widely in jewellery.